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United States Patent [19]

Miner et al.

[11] Patent Number: 6,021,181

[45] Date of Patent: Feb. 1, 2000

[54] ELECTRONIC VOICE MAIL MESSAGE HANDLING SYSTEM

[75] Inventors: Richard A. Miner, Cambridge; David M. Pelland, Boston; William J. Warner, Cambridge; Nancy Benovich Gilby, Concord, all of Mass.

[73] Assignee: Wildfire Communications, Inc., Lexington, Mass.

[21] Appl. No.: 08/804,548

[22] Filed: Feb. 24, 1997

[51] Int. Cl.[7] H04M 3/50

[52] U.S. Cl. 379/88.23; 379/88.04; 379/88.02

[58] Field of Search 704/275; 379/67, 379/88, 89, 210, 211, 212, 201, 88.23, 67.1, 88.02, 88.01, 88.04, 88.24, 88.22

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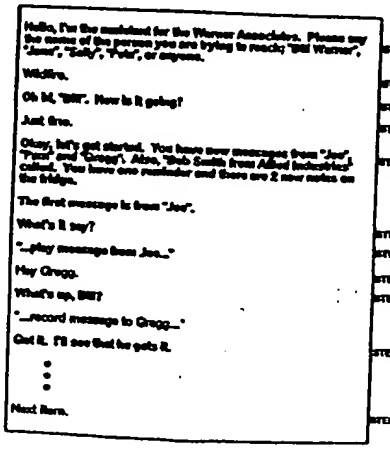
Attorney, Agent, or Firm—Fish & Richardson P.C.

[57] ABSTRACT

A virtual intercom method implemented by a computer-based electronic assistant and including the steps of receiving a voice command from a first party, wherein the voice command identifies a user selectable one of a plurality of subscriber parties; responding to the voice command by generating a greeting to the first party, wherein the greeting is an audio recording in the voice of the identified subscriber; receiving a message generated by the first party for the identified subscriber; and storing the received message for later playback to the identified subscriber.

2 Claims, 6 Drawing Sheets



The Electronic Receptionist: A Knowledge-based Approach to Personal Communications

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1. Absract

Proposed personal communications services will allow their users to be accessible anywhere and any time. Informal investigations with potential users revealed that these services would not be widely accepted without effective call prioritization and screening, akin to that provided by a human receptionist, to limit which calls get through and which are routed to colleagues or to voice messaging. An experimental, knowledge-based, electronic receptionist was constructed to investigate the features needed to facilitate personal communications. In this paper we describe our implementation and analysis of a knowledge-based system designed to emulate the work functions of a human receptionist. An iterative design methodology enabled rapid prototyping of numerous interfaces. Data from over 3,500 calls suggest that our electronic receptionist can significantly improve productivity and was perceived to have utility for both callers and clients.

2. Introduction

The substantial increase in the use of pagers, car phones, cordless telephones, and other wireless personal communications devices testifies to the fact that mobile communications is perceived by many to be an essential element of life in the 1990's [1, 2]. However, even with these devices, many people are still effectively out of reach because callers do not know which of their many numbers to call.

Communications service providers have proposed a *personal number calling* or PNC solution to this problem: a personal phone with a single number [2, 3]. The interworking between the plethora of wireline and wireless networks that is required to allow all people to be reached regardless of their location will take a number of years to accomplish. In the short-term (i.e., the next one to five years), we anticipate a number of interim solutions to this personal mobility problem that will use adjunct processors and the existing wireline and wireless communications infrastructure to achieve the desired end-user functionality. In the longer term some of these features will be incorporated into the public switched network through the Advanced Intelligent Network (AIN), and into PBXs and other switches through software additions.

The issue of obtaining a physical connection between caller and called party is not the only problem that must be addressed. In informal research on user attitudes about personal communications we discovered that the idea of being accessible 24 hours a day, 7 days a week to anyone that knows-your-personal number is an anathema to even the most enthusiastic embracers of new technology. The problem: answering the phone can be a waste of time and even annoying when you are interrupted from something more important. This is one of the objectives of Personal Communications Networks, e.g., "The difference with PCN will be the ability to maintain control without losing calls, screening them in real time so that important calls get through while others are deferred, but none are actually lost." [4] How do we allow people to be reachable anywhere and any time, but only by those individuals that they want to reach them? This is the subject of our research.

At the outset, we sought to determine how people dealt with the mobility problem today. In studying highly mobile individuals (e.g., sales people, doctors) it quickly became apparent that a good secretary or receptionist was the currently favored solution. Since good receptionists are hard to find, relatively expensive to employ and not on duty 24 hours a day, we sought to build a knowledge-based system that would automate the receptionist functionality -- specifically, the ability to make and receive calls on behalf of a client, and the ability to intelligently screen and route calls to a highly mobile user.

The work reported here began in June 1990 with the objective of exploring both the features and the human interface for personal communications services. After about 3 months of experiments, we arrived at a set of features and interfaces which were so well received by both callers and clients that we provided electronic receptionist service for the participants for over a year, until the experiment concluded in June 1991. We continued to experiment with incremental changes and numerous additional features, and the work became an exploration of how well a knowledge-based system could emulate the services of a good receptionist, and even improve on them.

These objectives were achieved and 10 clients (users) plus hundreds of callers had good, and even excellent, experiences with the system. In fact, when the experiment was completed and the system dismantled, some of the users virtually demanded, and even paid for, a follow on experiment. Also, a version is currently being used to route "help" calls in one portion of the computer support organization at Bellcore, and a new improved experimental version began operation in March 1992.

3. Design Criteria for the Electronic Receptionist

What does a good receptionist do? After studying the protocols of secretaries at Bellcore, we found that most employ a variation of the following:

1. Determine the name of the person calling and the subject of the call.

2. Make a judgment on whether this call is of sufficient importance that the person being called, the client, should be notified that there is a call waiting and, if so,

3. Locate the client (at work, in his or her car, at home, etc.), and relay the name of the caller and the subject of the call.

4. Carry out the client's wishes: connect the call, route to a colleague, or take a message.

In addition to performing these functions, a good receptionist answers the telephone promptly, is courteous, provides accurate information to the caller and the client, does not keep callers waiting for any appreciable time and performs the requested actions reliably.

In addition, for people who frequently travel, a receptionist in the home office frequently performs directory lookup and call transfer services when the client is traveling.

These criteria were established for the Electronic Receptionist design and testing.

4. Overview of the Electronic Receptionist

The electronic receptionist consists of two major applications: incoming call management and client service management (the client purchases the electronic receptionist service, and the caller places an incoming call to the service). Several other services are also provided by the experimental system. This paper provides a detailed description of the incoming call management, a less detailed description of the customer service management and only brief mention of the other services.

Incoming Call Management

The final realization of the incoming call management protocol is depicted in Figure 1. On receiving an incoming call, the electronic receptionist uses the information available: calling line identification, whether the customer is already on the telephone, and a knowledge base of the customer's profile, and the customer's current priority setting, to decide whether to attempt to reach the customer or to route the caller directly to voice messaging. If caller identification is available, and the caller's number is in the customer's profile, the importance of the caller can be determined to provide more effective screening.

If the electronic receptionist will attempt to locate the client, the caller is greeted with a recorded human voice, as with a human receptionist, and the caller's name and the subject of the call are recorded. The electronic

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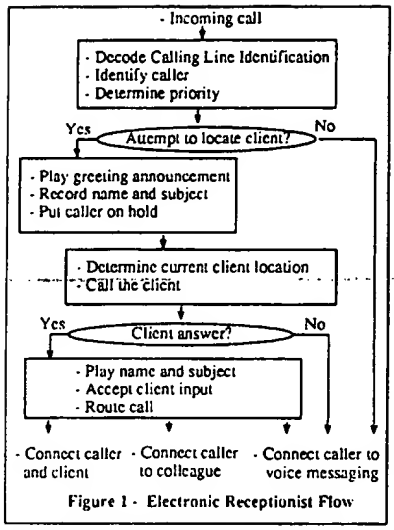


Figure 1 - Electronic Receptionist Flow

receptionist draws on the knowledge base for alternatives to reach the client, including telephones, cellular phones, pagers, etc. The electronic receptionist places a call to the appropriate number and plays the recorded name and subject of the call (or sends whatever information is possible on a pager, etc.).

On receiving the information, the client has several options: connecting to the caller or routing the caller to an associate or to voice messaging; these are selected by entering Touchtone digits.

Client Service Management

The client needs to be able to update the knowledge-base for the electronic receptionist, so we included client service management, even though it was not a major focus of the research. As the experiment progressed, we found that clients used this interface extensively (14% of the total calls processed by the system), so we refined the features and the interface for the client to manage the service, and also to provide additional useful features.

The final realization of the client service management interface is depicted in Figure 2. The client can update the knowledge base in the electronic receptionist from any Touchtone telephone or from any workstation which can connect to the Internet. The most frequent use is to change the current location, e.g., moving to a conference room telephone number. Another use is to set the priority threshold for accepting calls.

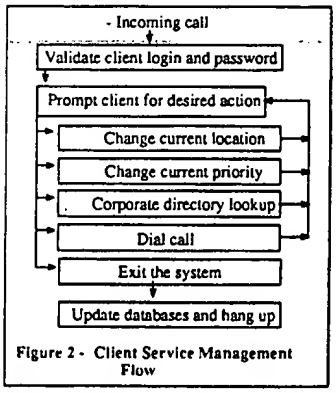


Figure 2 - Client Service Management Flow

A human receptionist can provide many additional communications services; several of these are simulated in the experimental system and have proven quite useful to clients. These include: providing access to a personal directory for speed calling (remembering a person's number and dialing it for the client), automatically logging on to the voice mail system, and providing instructions on how to use the Electronic Receptionist (a flexible help command).

Another service which has proven very useful is notifying the client, via a workstation, who is calling. This is faster than providing the voice access and spares the client from having to answer the phone; also the client can specify how to treat the call. These and other services are described in the sample remote login section.

5. Overview of the Mobility Platform

To facilitate the development of our 'electronic receptionist' we collaborated with S. G. Tell of the University of North Carolina at Chapel Hill in the design and construction of an experimental research prototype hardware and software platform called *Mobility*, which is depicted in Figure 3. A telephone line permits: placing calls on hold; placing a second call and either dropping the second call or connecting it to the first call; and forwarding calls to a voice messaging system or to another person.

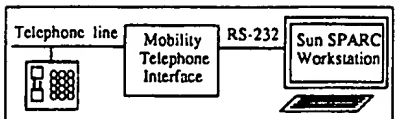


Figure 3 Mobility Platform Physical Implementation

The Mobility telephone interface provides interconnection with the wireline telephone network, detects network signals (ringing, busy, Touchtone digits, announcements), answers calls, sends dual tone multi-frequency (DTMF) signals to the network, flashes the switchhook, balances audio signals, and provides a serial interface to the workstation which serves as a master controller.

The workstation manages the overall communications process, including the recording and playing of announcements, storing and accessing the knowledge base, containing the client's current location, current priority and screening preferences, and executing the expert system shell to determine the most likely whereabouts of the person being called.

6. A Sample Call

To describe the operation of the electronic receptionist we will follow a call from Mr. Smith to his colleague Mrs. Jones, a client of the electronic receptionist. Both of their perspectives will be described, and alternatives will be identified, although the example ends with a completed call. We assume that Mrs. Jones has Mr. Smith in her knowledge base as an important caller. Figures 4a-e will show the actions being taken in the Mobility Telephone Interface platform.

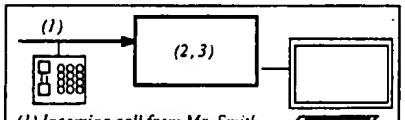


Figure 4a - Incoming call example to Mrs. Jones Electronic Receptionist

Mr. Smith calls Mrs. Jones number (*1*); the telephone interface receives the calling line identification digits (2), if available; and answers the call on the second ring (*3*).

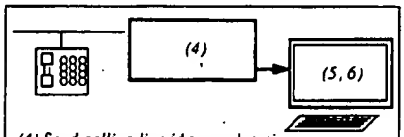


Figure 4b - Electronic Receptionist decides whether to try to locate Mrs. Jones

The telephone interface passes the calling line identification digits to the workstation (*4*), which looks up the information in the knowledge base (*5*), and decides whether to attempt to locate Mrs. Jones or to route the call directly to voice messaging (*6*).

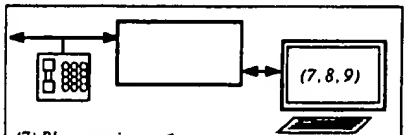
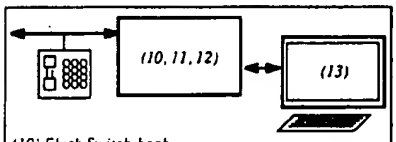


Figure 4c - Electronic Receptionist plays a greeting and records the call purpose

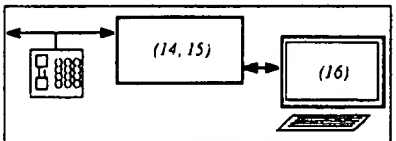
The workstation plays a greeting in a recorded human voice (*7*) , "Hello Mr. Smith, you have reached Mrs. Jones electronic receptionist. You have 4 seconds to record the purpose of your call." The workstation records for 4 seconds (*8*) and then plays an announcement (*9*), "Please wait while I attempt to locate Mrs. Jones."

The telephone interface flashes the switch-hook (*10*) to place the call on hold, and gets dial tone and dials the number (*11*) where Mrs. Jones can most likely be located. If the telephone is answered, i.e., ringing stops and no announcement is heard (*12*), the workstation plays an announcement, "Mrs. Jones, you have a call from Mr. Smith," and then the 4 second statement of the call's purpose (*13*). Note there are several alternatives here: the telephone may not be answered so either, a call to another number can be attempted to locate Mrs. Jones, or Mr. Smith may be routed to voice messaging with an announcement "Sorry, I was not able to locate Mrs. Jones."



(10) Flash Switch-hook
(11) Dial number
(12) Detect answer, busy, announcement, etc.
(13) Play "call from Mr. Smith" announcement and 4 second call subject recording

Figure 4d - Electronic Receptionist attempts to locate Mrs. Jones



(14) Receive Touchtone digit from Mrs. Jones
(15) Flash switch-hook
(16) Play "Your call is now connected" announcement

Figure 4e - Electronic Receptionist interaction with Mrs. Jones and final connection

Mrs. Jones enters a Touchtone digit (*14*) to select among: accept the call, transfer the call to a colleague or send the call to voice messaging. To make the connection the telephone interface flashes the switch-hook (*15*) to bridge Mrs. Jones and Mr. Smith, and plays an announcement (*16*) "Your call is now connected," which is heard by both of them. Note if Mrs. Jones had selected one of the other options, Mr. Smith would have heard a corresponding announcement and the appropriate action would be taken by the telephone interface.

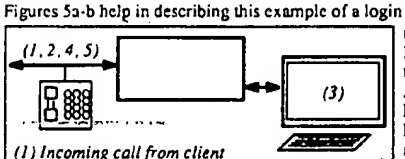
7. Sample Remote Login

We will describe most of the options available to the client in controlling the profile in electronic receptionist, and also the additional communications services provided. Other additional services are described in the conclusions and next steps section because they relate to services other than those normally provided by a human receptionist, and are part of our studies and experiments to extend the current model of communications to include other media and interactions between users and also with the network in negotiating communications, leading to a new paradigm for communications.

First, we will describe logging in from a touchtone telephone, and what can be accomplished. Then we describe the additional capabilities available from a workstation.

Telephone Login

Figures 5a-b help in describing this example of a login session from a telephone. The login begins with the client, Mrs. Jones, calling her Electronic Receptionist (*1*) and entering a "#" on her touchtone pad (*2*). She then hears an announcement (*3*), "Please enter your password," and enters her password using touchtone digits (*4*). Mrs. Jones can now enter a touchtone digit directly to select the service she wants (*5*), or if she waits more than 5 seconds she will hear an announcement of the menu of choices (*6*): "Please press '1' to change current location, press '2' to change current priority, press '3' to access the Bellcore directory, press '4' to use speed calling, press '5' to dial a call, or press '6' to login to voicemail or press '7' to exit.



(1) Incoming call from client
(2) Client enters touchtone "#"
(3) Play "Please enter your password" announcement
(4) Client enters password via touchtone
(5) Client enters touchtone selection
(6) Play menu announcement if wait >5 sec

Figure 5a - Electronic Receptionist remote login by Mrs. Jones

Mrs. Jones also has access to all of the features described above from her workstation. In particular, figure 6 describes the commands available to the client when using a workstation login.

8. Experimental Testing

We conducted extensive usability tests of our initial prototype in the second half of 1991 with 10 subjects drawn from a pool of Bellcore managers and members of the local community (a dentist, a psychologist, and an information worker). We iteratively designed the user interface based on feedback from both callers and clients until all clients collectively agreed on a satisfactory interface. (Where a discrepancy between the desires of two clients arose, we collectively worked out an interface specification agreeable to all participants.)

Remote Login Interface

Touchtone Digit	Command
1	change current location
2	change current priority
3	access the Bellcore directory
4	use speed calling
5	dial a call
6	login to voicemail
7	exit
Wait	hear menu

Figure 5b - Electronic Receptionist Touchtone Commands

Workstation Interface

log	Open a window to monitor calls
loc N	Change current location to telephone number N
pri L	Change current screening priority level to L
prf	Invoke the client's text editor on her profile to allow updating of speed calling lists, priority assignments, location tables, people recognized, etc.

Figure 6 - Electronic Receptionist Workstation Commands

9. Results

We analyzed 3539 calls made over a nine-month period on a consistent version of the system. The results of our analysis are summarized in Table 1, below.

Total s	Received Caller ID?	Yes		No
	Translated to Name?	Yes	No	
746 (21.1%)	connected-at desk	224 (6.3%)	136 (3.8%)	386 (10.9%)
628 (17.7%)	connected-outside	187 (5.3%)	122 (3.4%)	319 (9.0%)
37 (1.0%)	caller hangup	16 (0.5%)	10 (0.3%)	11 (0.3%)
115 (3.2%)	priority-reject	10 (0.3%)	20 (0.6%)	85 (2.4%)
1161 (32.8%)	noresp-vmail	374 (10.6%)	259 (7.3%)	528 (14.9%)
355 (10.0%)	defer-vmail	94 (2.7%)	52 (1.5%)	209 (5.9%)
497 (14.0%)	login	26 (0.7%)	11 (0.3%)	460 (13.0%)
3539 (100%)	Totals	931 (26.3%)	610 (17.2%)	1998 (56.5%)

* Entries are: number of calls in the category (% of the total calls)

Table 1 - Quantitative Results of Electronic Receptionist Experiments

We are still analyzing the results of the experiments. The principal results are reported here.

Almost as many calls were connected away from the desk as at it (18% vs. 21%), so the electronic receptionist is effective at finding the client. This significantly improves the productivity of both the client and the caller by reducing "telephone tag."

Fully 10% of the calls (or 1/4 as many as were answered) were deferred to voicemail, and 3.5% were rejected based on priority. These represent a significant saving for the client by reducing interruptions and saving the time of dealing with these less important calls.

The use of the caller statement of name and purpose of the call is very helpful in screening the calls, especially since auto-dialers and other junk calls usually do not respond to this and thus are more effectively screened (or just hang up because they realize they will not get through)

Whether caller ID was received or whether the name was found in the client's profile, has relatively little impact on call outcome except that priority rejects are higher when caller ID was not received. However, this may be due to the pattern of which calls had caller ID: all the intra-Bellcore calls and greater than 65% of the calls from the 201 NPA; while caller ID is not available on any cellular calls or out of state calls. The client can thus use this as a discriminator by who was calling. Similarly, those calls translated to name represent the frequent callers calling from these local areas.

The caller hangup rate, 1%, is negligible -- this was at least partially the result of refining the announcements and algorithms from earlier versions of the electronic receptionist which had much higher hangup rates. Furthermore, many of those who hangup are experienced callers who know from the timing whether the client will be reached or not, and, from detailed call analysis many of the remaining are junk calls (e.g., automatic dialers or salespeople). Thus the hangup rate for inexperienced callers making valid calls is almost zero; in fact, we received many unsolicited positive responses from first time callers.

Originating services (speed dialing, checking voice mail, directory lookup, etc.) are significantly used services, with 14% of the total calls (note that these must be removed before comparisons of other statistics by information on the call can be valid). The fact that most these did not have caller ID reflects calls from either cellular or out of the 201 NPA.

Half of the incoming calls (not counting logins) are sent to voicemail. This indicates the important role voice mail play, and thus closer integration with voicemail is important (several features for future inclusion have been identified).

Half of the incoming calls did not have the calling line ID available which makes automated treatment less effective (rapid extensions to SS7 and Interexchange Carrier connectivity will help this substantially).

Subjectively, some people like to have the system recognize them and say their name because they felt that they were getting customized treatment and clients feel that they can make a more informed decision on how to treat calls; however, others feel that saying their name violates their privacy.

10. Conclusions and Next Steps

The electronic receptionist has been extremely successful in serving the needs of our current "clients" and the hundreds of people that have called them. At the end of 1991, it had processed well over 4,000 calls. Based on these results and on phenomenological reports from users, we conclude that:

1. The value of personal communications services is enhanced by the use of the electronic receptionist.

2. From the user's perspective, the receptionist helps to maintain continuity in work flow: users are interrupted only when they desire to be; increased completion of calls maintains continuity instead of trading voice mail messages.

3. Most callers, if not regularly screened out by the interface, find the system highly beneficial as well. The ability to access an individual with one number rather than having to try a series of numbers is a substantial benefit.

While we have begun to make progress in defining a new protocol for personal communications, there is still much work to be done. In particular, the protocol used here (and that used by human receptionists) is inherently one sided: the caller makes a request, which is accepted or denied by the called person.

In future papers we will document our proposal for a model of communications based on negotiations between both parties. We have experimented with this model in unifying communications and information processing and will report on our experiments with filtering information and communications requests in a common framework.

Thus services such as scheduling a conference call, requesting to speak with a person (as this paper described), notification of current news events meeting the screening criteria, roaming with a cellular telephone, notification by alphanumeric pager of events, voice reading of email, etc. all fit within the scope of this unified model.

We believe this is the direction for personal communications in the future, and have done extensive modeling and experimentation to demonstrate and explore these aspects.

11. Summary

This paper begins with a summary of the design criteria and an overview of the Electronic Receptionist and the Mobility Platform which implemented the experiments. Next we provide a detailed description of how a typical incoming call is handled by the Electronic Receptionist, including the perspectives perceived by the caller and the client of the Electronic Receptionist, and the operation of the Mobility Platform to accomplish the features. At each stage of the example, options and alternative paths are identified, although not in their entirity. Next we describe the testing program and then the results and conclusions from the experiments, and finally we give an indication of some of the other features which were tested in the experiments and how these fit into a larger service context.

Subsequent papers will provide more details on the analysis of results of this experiment and a description and the results of other experiments now in progress on additional services and features. These include work with other media of communications, directory services, and delivering other information, such as news.

12. References

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